CLAIMS

1. A method of making biodiesel comprising the following steps:

(a) providing a vegetable oil source comprising free fatty acids, glycerides, or mixtures thereof;

(b) providing methanol in an amount between about 1.0 molar equivalent to about 5.0 molar equivalents compared to the total moles of free fatty acids, glycerides, or mixtures thereof;

(c) mixing the methanol and the vegetable oil source in the presence of a catalytic acid to form a reaction mixture, wherein the catalytic acid comprises an amount between about 0.1 wt% to about 2 wt% compared to the weight of the vegetable oil source;

(d) heating the reaction mixture to a temperature of between about 80°C to about 200°C;

(e) maintaining a pressure above ambient for the heated reaction mixture;

(f) reacting the reaction mixture for a sufficient reaction time to produce a reaction product comprising fatty acid alkyl esters; and

(g) recovering the fatty acid alkyl esters.

2. The method of claim 1, wherein the reaction mixture is heated to a temperature of between about 120°C to about 180 °C.

3. The method of claim 2, wherein the reaction mixture is heated to a temperature of between about 150°C to about 170°C.

4. The method of claim 1, wherein the catalytic acid is present in an amount between about 0.1 wt% to about 0.25 wt% compared to the weight of the vegetable oil source.

5. The method of claim 1, wherein the methanol comprises between about 1.5 molar equivalents to about 3.0 molar equivalents compared to the total moles of free fatty acids or glycerides.

6. The method of claim 1, further comprising a step of removing by-products of reaction during processing.

7. The method of claim 1, wherein the reaction mixture reacts substantially to completion.

8. The method of claim 1, wherein greater than about 85.0 grams of biodiesel per 100 grams of vegetable oil source are produced.

9. The method of claim 1, wherein the reaction mixture has a starting acid value between 107 - 187.

10. The method of claim 1, wherein the reaction product has an acid value less than about 10.0.

11. The method of claim 10, wherein the reaction product has an acid value of less than about 2.5.

12. The method of claim 1, further comprising the step of removing dissolved water from the reaction product and then subjecting it to further reaction.

13. The method of claim 12, wherein the step of removing dissolved water comprises vacuum drying the reaction product.

14. The method of claim 1, wherein the reaction time is less than about 5 hours to proceed to greater than about 80.0% completion.

15. The method of claim 14, comprising a total reaction time of less than about 2.5 hours to proceed to greater than 80.0% completion.

16. A method of making biodiesel comprising the following steps:

(a) providing a vegetable oil source comprising free fatty acids, glycerides, or mixtures thereof;

(b) providing methanol in an amount between about 1.5 molar equivalents to about 3.0 molar equivalents compared to the total moles of glycerides, free fatty acids, or mixtures thereof;

(c) mixing the methanol and the vegetable oil source in the presence of a catalytic acid to form a reaction mixture, wherein the catalytic acid comprises an amount between about 0.1 wt% to about 2 wt% compared to the weight of the vegetable oil source;

(d) heating the mixture to between about 150°C to about 170°C;

(e) maintaining a pressure above ambient for the heated mixture;

(f) reacting the methanol with the free fatty acids, glycerides, or mixtures thereof for a sufficient reaction time to produce a reaction product comprising fatty acid alkyl esters; and

(g) recovering the fatty acid alkyl esters.

17. The method of claim 16, further comprising a step of removing by-products of reaction during processing.

18. The method of claim 16, wherein the reaction mixture has a starting acid value between 107 - 187.

19. The method of claim 16, wherein the reaction product has an acid value less than about 10.0.

20. The method of claim 16, wherein the reaction product has an acid value less than about 2.5.

21. The method of claim 16, wherein the reaction time is less than about 5 hours to proceed to greater than about 80.0% completion.

22. The method of claim 16, wherein the vegetable oil source is acidulated soap stock.

23. A product produced according to the method of claim 1.

24. A product produced according to the method of claim 16.

25. A method of making alkyl esters comprising the following steps:

(a) forming a reaction mixture comprising:

(i) a vegetable oil source in an amount between about 60 wt% to about 90 wt% of the total weight of the reaction mixture, wherein the vegetable oil source comprises free fatty acids, glycerides, or mixtures thereof;

(ii) methanol in an amount between about 10 wt% to about 40 wt% of the total weight of a reaction mixture.

(iii) a catalytic acid in an amount between about 0.05 wt% to about 2 wt% compared to the weight of the vegetable oil source;

(b) heating the reaction mixture to a temperature of between about 120°C to about 180°C;

(c) maintaining a pressure above ambient for the heated reaction mixture;

(d) reacting the reaction mixture to produce a reaction product comprising fatty acid alkyl esters; and

(e) recovering the fatty acid alkyl esters.

26. The method of claim 25, wherein the reaction mixture is heated to a temperature of between about 150°C to about 170°C.

27. The method of claim 25, further comprising a step of removing by-products of reaction during processing.

28. The method of claim 25, wherein greater than about 85.0 grams of biodiesel per 100 grams of vegetable oil source are produced.

29. The method of claim 25, wherein the reaction product has an acid value less than about 10.0.

30. The method of claim 25, wherein the reaction product has an acid value less than about 2.5.

31. The method of claim 25, further comprising a step of removing dissolved water from the reaction product and then subjecting it to further reaction.

32. The method of claim 25, wherein the reaction time is less than about 5 hours to proceed to greater than about 80.0% completion.